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Elementary Meteorology. By WILLIAM MORRIS DAVIS, Professor of Physical Geography in Harvard College. Boston, U. S. A. Ginn & Co., Publishers, 1894, pp. XII.+355.

THE announcement, made some months ago, that Prof. Davis was about to publish a work on meteorology, was hailed with satisfaction by all those interested in this branch of natural science. The book, which has recently been issued by Ginn & Co., presents the condensed results of the author's reading, observation, and teaching during the last fifteen years. Since it has been prepared by one who is not only eminent as an original investigator, but also as an experienced teacher, it is scientific in its treatment, fully in accord with the latest advances in meteorology, and, at the same time, well fitted for the use of college students of the more advanced years. In so far as the experience of the writer goes, this book would seem to be better adapted to the abilities of juniors and seniors of the majority of our colleges than to the "later years of a high-school course, or the earlier years of a college course," as the author suggests in the preface.

The plan of the book is stated by the author at the outset, as follows: "The origin and uses of the atmosphere are first considered, with its extent and arrangement around the earth. Then, as the winds depend on differences of temperature over the world, the control of the temperature of the atmosphere by the sun is discussed, and the actual distribution and variations of temperature are examined. Next follows an account of the motions of the atmosphere in the general and local winds; in the steady trades of the torrid zone, and in the variable westerly winds of our latitudes. The moisture of the atmosphere is then studied with regard to its origin, its distribution, and its condensation into dew, frost, and clouds. After this, we are led to the discussion of those more or less frequent disturbances, which we place together under the name of storms; some of them being large, like the great cyclones or areas of low pressure on our weather maps; some of them very small, like the destructive tornadoes. The effect of these storms and of other processes in the precipitation of moisture as rain, snow, and hail is next considered. Closing chapters are then given to the succession of atmospheric phenomena that ordinarily follow one another, on which our local variations of weather depend, together with some account of weather prediction; and another on the recurrent average conditions that we may expect, in successive seasons, repeated year after year, which we call climate."

The above statement gives an idea of the scope and method of treatment of the subject. There are a few points, however, which deserve more particular mention. In chapter III., the distribution over the earth of the insolation, or radiant energy received by the earth, is discussed, and by means of a very ingenious diagram, the amount of insolation for all latitudes for each month of the year is graphically shown. A detailed discussion of the various processes of absorbtion, conduction, radiation, and convection, by means of which the atmosphere gains and loses heat, is given. In the course of this the author takes exception to the statement, so common in most physical geographies, in which the atmosphere is "compared to a trap which allowed sunshine to enter easily to the earth's surface, but prevented the free exit of radiation from the earth." In reality, the coarse-waved radiation from the earth passes out readily without great absorbtion, either by the clear air or the water-vapor, which has been proved to be as poor an absorber as pure dry air.

Again, the exact processes, by which convectional circulation is set up, are clearly brought out, and the incorrectness of such loose statements, as "the air is heated and rises, and the cold air rushes in from either side to fill the vacuum thus formed," is emphasized.

A general review of the distribution of pressures and the circulation of the winds shows the student two particulars, in which the expected arrangement of pressures and motions according to the theory of convection, as applied to the origin of winds, are contradicted by the facts. The polar pressures are high, not low, the highest pressures occur around the tropics, where intermediate pressures were expected, and the winds do not follow the gradients, but are systematically deflected. Either the convection theory is fundamentally wrong as an explanation for the winds, or it needs to be supplemented by some factors up to this time unconsidered. This fact the author brings clearly to the mind of the pupil, who is then led to see that, perhaps, the oblique course of the winds may account for the distribution of pressures at the poles and the tropics. The cause of the oblique course is found in the deflecting influence of the earth's rotation. It is proportionate to the velocity of motion, and increases from zero at the equator to a maximum value at either pole, but it does *not* depend upon the direction in which the body is moving. In this connection, the author points out another error found in many text-books, namely that the oblique course of the winds is due to a lagging behind, as they move from regions of less to those of greater rotary velocity, and, therefore, that winds traveling due east would not be deflected at all. As was clearly shown by Ferrel, many years ago, both the explanation and its corollary are wrong, although they have appeared in many text-books, even of recent date.

Following the discussion of a competent theory for the general circulation of the winds, there is given a systematic account of the different members of the circulation, and a classification of winds according to cause into (1) planetary, (2) terrestrial, (3) continental, (4) land and sea breezes, (5) mountain and valley breezes, (6) cyclones and other storms, (7) eclipse winds, (8) landslide and avalanche blasts, (9) tidal breezes, (10) volcanic storms.

Chapter X., treating of cyclonic storms and winds, is one of the most interesting and valuable in the book. The tropical cyclones are first considered. The evidence of convectional action in these cyclones is considered, and it is shown that their distribution both in time and place points strongly to the theory that they originate through the overturning of great masses of air, due to unequal heating. But it is clearly pointed out to the pupil that it has not yet been directly shown that the temperature of the cyclonic mass is higher than that of the surrounding atmosphere at corresponding altitudes, a condition which, of course, must be satisfied before convection can take place. If this shall, hereafter, be shown *not* to be the case, the convectional theory will have to be abandoned.

In points like this, Prof. Davis' book is particularly good, for, all along, he has stated clearly not only what is certainly known, what is probable, and what is doubtful, but also what is not known. This prevents the student from forming misconceptions of the subject, or dropping into loose habits of thought.

The extra-tropical cyclones are closely compared with the tropical cyclones, and their points of likeness and difference shown. Two theories for their origin are discussed, and lines are indicated along which the rival theories may, some day, be tested, but here again, the fact is emphasized that much is not yet known, and that positive didactic statements are to be avoided.

Space will not permit even a brief mention of many other points to which we should like to call attention. The subjects of thunderstorms, rainfall, weather, and climate receive careful consideration. The text is illustrated by many maps and diagrams, of which a number are original. The generalized charts, showing the winds of the Atlantic and Indian Oceans, taken from the atlas of the German Naval Observatory, are particularly valuable. But a few of the diagrams, although showing clearly what they were intended to represent, fall short of the standard of artistic excellence set by the others.

The value of this book lies, if in some things more than in others, in the logical treatment of the subjects, the frequent turning aside from the discussion for the purpose of introducing additional facts in order to correct, modify or substantiate hypotheses, and the clear discrimination, between facts, well-established theories, and working hypotheses. The pupil, who uses this book intelligently, will learn, not only many things about meteorology, but what is far more valuable, true scientific methods of thought, study, and work.

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